Levels of Demands

Lower-level demands (memorization):

- Involves either reproducing previously learned facts, rules, formulas, or definitions or committing facts, rules, formulas or definitions to memory.
- Cannot be solved using procedures because a procedure does not exist or because the time frame in which the task is being completed is too short to use a procedure.
- Are not ambiguous. Such tasks involve the exact reproduction of previously seen material, and what is to be reproduced is clearly and directly stated.
- Have no connection to the concepts or meaning that underlie the facts, rules, formulas, or definitions being learned or reproduced.

Lower-level demands (procedures without connections):

- Are algorithmic. Use of the procedure either is specifically called for or is evident from prior instruction, experience, or placement of the task.
- Require limited cognitive demand for successful completion. Little ambiguity exists about what needs to be done and how to do it.
- Have no connection to the concepts or meaning that underlie the procedure being used.
- Are focused on producing correct answers instead of on developing mathematical understanding.
- Require no explanations or explanations that focus solely on describing the procedure that was used.

Higher-level demands (procedures with connections):

- Focus students' attention on the use of procedures for the purpose of developing deeper levels of understanding of mathematical concepts and ideas.
- Suggest explicitly or implicitly pathways to follow that are broad general procedures that have close connections to underlying conceptual ideas as opposed to narrow algorithms that are opaque with respect to underlying concepts.
- Usually are represented in multiple ways, such as visual diagrams, manipulatives, symbols, and problem situations. Making connections among multiple representations helps develop meaning.
- Require some degree of cognitive effort. Although general procedures may be followed, they cannot be followed mindlessly. Students need to engage with conceptual ideas that underlie the procedures to complete the task successfully and that develop understanding.

Higher – level demands (doing mathematics):

- Require complex and nonalgorithmic thinking – a predictable, well-rehearsed approach or pathway is not explicitly suggested by the task, task instructions, or a worked-out example.
- Require students to explore and understand the nature of mathematical concepts, processes, or relationships.
- Demand self-monitoring or self-regulation of one's own cognitive processes.
- Require students to access relevant knowledge and experiences and make appropriate use of them in working through the task.
- Require students to analyze the task and actively examine task constraints that may limit possible solution strategies and solutions.
- Require considerable cognitive effort and may involve some level of anxiety for the student because of the unpredictable nature of the solution process required.

These characteristics are derived from the work of Doyle on academic tasks (1988) and Resnick on high-level-thinking skills (1987), the Professional Standards for Teaching Mathematics (NCTM 1991), and the examination and categorization of hundreds of tasks used in QUASAR classrooms (Stein, Grover, and Henningsen 1991; Stein, Lane, and Silver 1996)

Smith, Margaret Schwan, and Stein, Mary Kay. " Selecting and Creating Mathematical Tasks: From Research to Practice." **Mathematics Teaching in the Middle School** Vol 3, No. 5 February 1998: p. 344-349

Tasks (A – H)

Using the "Levels of Demand" chart above, rank the following:

A. Find the smallest positive integer that has exactly 13 factors.

B. Factor the following polynomials:

a. $x(x + 1) – 3(x + 1)$
b. $x^2 + 5x + 6$
c. $4x^2 – 25$
d. $27x^3 + 8$

C. State the triangular and unit circle definitions for sin α, cos α, and tan α.

D. Insert parentheses to make each statement true:

a. 2 X 14 – 9 – 17 – 14 = 7
b. 16 + 5 X 4/2 = 42
c. 64/8 + 24 –1 = 1
d. 36/3 – 9/3 = 1

E. Solve this equation by factoring:

$x^2 – 7x + 12 = 0$

Explain how the factors of the equation relate to the roots of the equation, and how you could use that information to draw a sketch of the parabola. Then draw the sketch.

F. Use the table of values below to draw a graph of the function represented. Then use the graph to write the equation of the function. Then use the equation of the function to find f(5), f(-11), and f(1/2). Also use the function to find x is f(x) = 218.

x	f(x)
1	-1
2	3
0	-3
-2	-7

G. A 25-foot ladder is placed against a building. The bottom of the ladder is 7 feet from the building. If the top of the ladder slips down 4 feet, how many feet will the bottom slide out? No, it is not 4 feet. This is a two-step problem, so draw two right triangles.

H. Write the next two rows of the pattern:

1
3 5
7 9 11
13 15 17 19
21 23 25 27 29

Investigate the difference between the first number in a row and the last number in that row. Find a pattern and write a rule.

Investigate the sum of all the numbers in a row. State your rule. Then use the rule to find the sum of the numbers in the 30^{th} row.

Discuss in small groups then whip around the whole group to report findings.